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DEVELOPING A NUTRIENT BUDGET MODEL FOR ISABGOL (*Plantago ovata*) PRODUCTION CONSIDERING SOIL PROPERTIES AND ENVIRONMENTAL FACTORS

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ABSTRACT

The purpose of this research study is to create a nutrient budget model for the production of isabgol (Plantago ovata L), taking into consideration the qualities of the soil and the external influences. The proper management of nutrients is essential for increasing agricultural yields and making the most efficient use of available resources. The creation of a detailed nutrient budget model has the potential to provide useful insights into the dynamics of nutrients in Isabgol agriculture and to enable the implementation of precise nutrient management strategies. In-field experiments and theoretical modeling methodologies were used throughout the course of the investigation. In order to ascertain the baseline nutrient levels in the Isabgol fields, soil samples were taken from a variety of Isabgol fields, and nutrient assays were performed on the samples. During the course of the growing season, environmental variables such as rainfall, temperature, and the amount of moisture in the soil were tracked. A model of the nutrient budget was developed using the data from the field trials. This model took into consideration the inputs, outputs, and transformations of the various nutrients. According to the findings, the features of the soil as well as environmental variables had a substantial impact on the nutrient dynamics of the Isabgol agriculture. Both the availability of nutrients and their capability to be retained in the soil were affected by the features of the soil, such as its organic matter content, cation exchange capacity, and nutrient holding capacity. Environmental conditions, in particular precipitation and the moisture content of the soil, had an effect on the leaching and discharge of nutrients, which in turn had an effect on the amount of nutrients lost from the system. The nutrient budget model that was created offered a quantitative framework for estimating the nutritional inputs and outputs involved in the manufacturing of isabgol. It took into account a wide variety of nutrient inputs, including fertilizers, organic amendments, and atmospheric deposition, in addition to nutrient losses caused by leaching, runoff, and crop absorption. This allowed the model to mimic nutrient dynamics throughout the course of the growing season and give insights into nutrient needs and management options. The model took into account soil parameters as well as environmental conditions. The nutrient budget model was used to develop suggestions for accurate nutrient management in isabgol production. These recommendations are based on the results. When it comes to estimating the amount of nutrients to apply, these instructions stress how important it is to take into account the features of the soil, such as its organic matter content and its ability to store nutrients.

Keywords: *Isabgol Production, Considering Soil, Environmental factors*

INTRODUCTION

Isabgol is a short-stemmed annual herb that grows to a height of 10–45 centimeters and is a member of the Plantaginaceae family. It is also known by a variety of other names, including ashwagolam, aspaghol, aspagol, bazarqutuna, blond psyllium, ch'-ch'ientzu, ghoda, grappicol, Indian plantago, Its leaves emerge either alternately on the stem or in rosettes that are directed toward the surface of the soil. The number of leaves that are produced by a single plant may range from 40 to 86, and each one is linear, strap-shaped, recurved, 6.0-25 centimeters in length, and 0.3-1.9 centimeters in width. The surface of the leaf is either completely glabrous or very faintly hairy. The spikes may be cylindrical or ovoid in shape and range in length from 0.6 to 5.6 cm. On the spike, the flowers are arranged in a spiral pattern, making up four rows. Petals are also four in number, glabrous, reflexed, and white in color, but sepals are four in number, free, concave, elliptic, and glabrous.

The ovary has two chambers, each of which contains a single ovule, and the placentation occurs in the axils. Ovate or ellipsoid in shape, the capsule dehisces around the ring of abscission tissue that is produced around the capsule. Isabgol is cultivated in mild temperate areas between 26 and 36 degrees north latitude. The species that make up Isabgol are native to the area around the Mediterranean and west Asia, going all the way up to west Pakistan. Isabgol has been used in the treatment of medical conditions since ancient times; nevertheless, as a medicinal plant, it has only been grown in recent decades. Mucilage, fatty oil, huge amounts of albuminous materials, a pharmacologically inactive glucoside known as aucubin (C13 H19 O8 H2O), and a plantiose sugar may be found in the seed of this plant. Isabgol seed husk has the ability to absorb water and keep it in its structure, which is the primary reason for its effectiveness in preventing diarrhea. Diuretic, relieves symptoms of kidney and bladder disorders, gonorrhea, arthritis, and hemorrhoids; relieves constipation.

In general, plants that are considered medicinal have a high concentration of secondary metabolites and have the potential to be used as pharmaceuticals. The biosynthesis of secondary metabolites is regulated genetically and highly impacted by environmental variables (Yanive and Palevitch, 1982; Omidbaigi, 2000). The sowing date is a necessity for ensuring ideal ecological circumstances throughout the growth and development of the plant, and it is one of the environmental elements that has a substantial influence on the biosynthesis of secondary metabolites. It has been said that the best time to seed isabgol in this particular location, Jammu, is between the middle of October and the middle of November. Late sowing, which occurs after the winter rainy season has ended, has a negative impact on seed production because of the shorter growing time. However, it has been claimed that the first week of December is the best time to seed Plantago ovata. This timing is thought to be optimal. Concerning the impact that nitrogen has on Plantago ovata, it was said that an increase in the amount of nitrogen applied, from 0 to 50 kg ha-1, results in a decrease in the amount of nitrogen concentration as well as the swelling factor of Plantago seeds. It has been found that an increase in the amount of nitrogen application resulted in an increase in the seed yield. The application of forty to eighty kilograms of hectare-1 of nitrogen resulted in the largest seed production ever reported in the Tarai region. This study aimed to discover the effect of some environmental factors, such as the suitable sowing date and nitrogenfertilizer, which could be used for isabgol cultivation to increase the quantity of and improve the quality of isabgol productivity, as well as to clarify the relationship between measured characteristics. These goals were intended to be accomplished by discovering the effect of certain environmental factors, such as the suitable sowing date and nitrogenfertilizer.

OBJECTIVES

1. The Study Isabgol Production Considering Soil Properties And Environmental Factors.

2. The Study Soil Samples Were Collected From Isabgol Fields With Varying Soil Properties.

RESEARCH METHODOLOGY

A split-plot arrangement of a randomized full block design was used for this study's statistical design, and there were three replicates of each treatment. The major plot consisted of the planting dates, which were the fifth and twentieth of April and the fifth and twentieth of May, respectively. It is important to note that seeds planted on April 5th grew properly at first, but were eventually thrown away due of cold stress that they experienced. As a result, the other three possible sowing dates—the 20th of April, the 5th of May, and the 20th of May—were taken into consideration for this task. The impact of nitrogen fertilizer was tested in sub-plots, where seeds were sowed in rows spaced 30 cm apart and 5 cm apart, while the sub-plots themselves were separated by 30 cm. In addition to a control that had not been treated in any way (0 level), three distinct nitrogen levels in the form of urea ranging from 50 to 100 to 150 kg ha-1 were employed. Nitrogen was employed on two separate occasions: the first time was two days before to planting, and the second time was while the plant was in the blooming stage. We took into account factors such as plant height, the number of blooms and branches on each plant, the average seed weight, and the swelling factor. The swelling factor was determined by placing one gram of seeds in twenty milliliters of deionized water for a period of twenty-four hours. This research was conducted at the experimental station of Zanjan, which is situated in the northwestern corner of Iran at a latitude of 36 degrees 40 minutes north and an elevation of 48 degrees 26 minutes above sea level. The climate of the station may be described as semiarid and somewhat chilly, with an annual precipitation of 263 millimeters. The mean annual low temperature is 3.9 degrees Celsius, while the mean annual high temperature is 18 degrees Celsius. The following is a list of the soil's characteristics: 15% sand, 45% clay, 40% silt, pH 7.6, 334 ppm K, 7.8 ppm P, 0.082 ppm total N, and 0.82% organic carbon. Sand content is 15%, clay content is 45%, and silt content is 40%. According to the findings of this investigation, the soil was amended with a quantity of 100 kg ha-1 triple super phosphate that contained 46% active ingredient. We regressed the plant height,

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which allowed us to discover any potential relationships.

DATA ANALYSIS

The results of an analysis of variance are shown in Table 1 and demonstrate that the date of sowing has a very significant impact on plant height, number of branches, number of flowers produced per plant, and seed production. presents the results of the comparisons of the characters' means that were discussed before. The growth of the plants that were planted on May 5 was noticeably superior than that of the ones that.

Table 1. Analysis Of Variance For Six Growth Characteristics Of Plantago Ovata.

			Mean Squares (MS)			
Source of Df	Plant	No. of	No. of	1000 Seed	Seed	Swelling
Variation	Height	Branches	Flowers	Weight	Yield	Factor
	(cm)	per $Plant^{-1}$	per $Plant^{-1}$	(g)	($g\ m^{-2}$)	(mm)
Block 2	1.251^{ns}	0.025^{ns}	0.414^{ns}	0.05^{ns}	8.651^{ns}	0.09^{ns}
Sowing 2	147.679^{***}	32.077^{***}	53.534^{***}	0.285^{*}	2695.736^{***}	15.715^{**}
Error 1 4	1.254	1.521	2.824	0.025	7.936	0.392
Nitrogen 3	8.903^{***}	5.939^{***}	13.336^{***}	0.192^{***}	379.009^{***}	5.933^{***}
AB 6	0.832^{ns}	0.402^{ns}	0.882^{ns}	0.014^{ns}	41.039^{***}	0.252^{**}
Error 2 18	0.355	0.172	0.401	0.024	5.542	0.069

Using the Minitab Statistical Software Package (Ryan and Joiner, 2001), we looked at the number of branches and blossoms on each plant as independent variables, as well as the weight of one thousand seeds and the seed production. We looked at the seed swelling as a dependent variable. In addition, a stepwise multiple regression analysis was carried out in order to investigate the independent factors that had a statistically significant impact on the dependent variable (seed swelling) and the formulation of the dependent variable. Duncan's Multiple Range test, also known as LSR, was used in the process of computing the statistical mean comparisons**).**

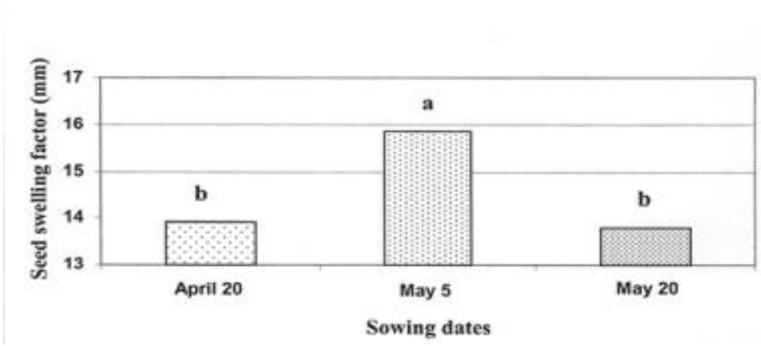

Figure 1. Effect Of Sowing Dates On The Seed Swelling Factor Of Plantago Ovata. Histograms With The Same Latter Symbols, According To Duncan's Multiple Range Test, Are Not Significantly

Effect of Nitrogen-Fertilizer

impacted not only the growth but also the seed characteristics as well as the swelling factor that was determined in this experiment. Table 3 presents the results of a comparison of the mean values for each of these characters. The application of nitrogen fertilizer at a rate of 100 kilograms per hectare per year seems to provide the greatest outcomes for this plant in terms of the majority of its growth characteristics. Isabgol seeds that were treated with this quantity of nitrogen also produced the greatest degree of seed swelling (15.6 mm; see Figure 2 for details). Therefore, it can be determined that the ideal treatment for the growth of Plantago ovata is to use 100 kg ha-1 nitrogen, applying half of it before. This will ensure that the plant receives the optimal amount of nitrogen.

Plants with a history of medical use are likely to be high in secondary metabolites and to have the potential to be used as pharmaceuticals. In medicinal plants, the manufacture of secondary metabolites is controlled genetically, but environmental conditions also play a significant influence (Yanive and Palevitch, 1982; Omidbaigi, 2000). This process is called secondary metabolite biosynthesis. Sowing dates showed conspicuous effects on all growth and seed characteristics examined on Plantago ovata. Environmental factors such as cultivation practices (such as sowing date, fertilizerlevel, and water supply) have been shown to have a significant impact on plant growth and the production of secondary metabolites (Yanive and In this work, sowing dates showed a significant impact. These findings are in conformity with those that were published by Koul and Isabgol. Seeds that were sowed on April 5 were initially growing properly, but once chilling stress occurred, they were rejected. The conclusion that can be drawn from this is that isabgol is susceptible to cold; hence, the seeds of this plant should not be planted during the first few weeks of spring.

To put it another way, the cold weather that occurs early in the spring in the Zanjan area may be detrimental to the germination of isabgol seeds and may inhibit the early stage of seed development. According to the data that were gathered as a consequence of these experiments, the fifth of May, which was one of three sowing dates that were investigated, was determined to be the most optimal sowing date for Plantago ovata at the Zanjan experimental station. Furthermore, all of the growth characteristics and the swelling factor of Isabgol were clearly influenced by nitrogen fertilizer in the present work. This led to the discovery that the best treatment for cultivation of Plantago ovata is to use 100 kg ha-1 nitrogen in the above-mentioned experimental station, applying half of which as pre-sowing and the other half as flowering stage fertilization. The data shown here are in line with the findings published by previous researchers (Singh and Nand, 1988; Ramash et al., 1989; Ganpat et al., 1992), which show that this phenomenon does occur. In the meanwhile, the Isabgol seeds that were cultivated with 100 kg ha-1 of nitrogen had the greatest amount of seed swelling when compared to the other conditions. The stepwise regression analysis confirmed that the seed yield, in addition to other aspects of growth and seed characteristics that were investigated for this study, had a significant impact on the seed swelling factor.

CONCLUSION

This research aimed to construct a nutrient budget model for the production of isabgol (Plantago ovata L), taking into consideration the characteristics of the soil as well as the external influences. The outcomes of this study highlight how important it is to cultivate isabgol while adhering to certain nutrient management strategies and having a thorough grasp of the dynamics of nutrients. According to the findings, the characteristics of the soil, such as its organic matter content, cation exchange capacity, and nutrient holding capacity, had a substantial impact on the availability of nutrients and their capability to be retained in the Isabgol fields. Farmers and agronomists are able to adapt fertilizer application rates to fit the unique nutritional needs of Isabgol plants, which promotes optimum development and production. This is accomplished by taking into consideration the qualities of the soil. In addition, environmental conditions, notably precipitation, temperature, and the amount of moisture in the soil, played a significant impact in the cycling of nutrients. Managing these parameters, via suitable irrigation and drainage techniques, may assist decrease nutrient losses through leaching and runoff, hence increasing nutrient usage efficiency in Isabgol production. This can be accomplished by minimizing nutrient losses through leaching and runoff. The nutrient budget model that was established offered a quantitative framework for predicting the amounts of nutrients that went into and came out of the isabgol manufacturing process. The model provides insights into nutritional needs as well as management techniques by taking into account a number of different sources and losses of nutrients. This gives farmers the ability to make educated judgments about the rates, timing, and methods of applying nutrients, which helps them to maximize the use of their resources while reducing their negative effects on the environment. The conclusions and suggestions that were drawn from this study emphasize how critical it is to implement accurate nutrition management procedures that are based on the nutrient budget model. Farmers are able to establish targeted nutrient management techniques that encourage sustainable Isabgol production if they take into account the qualities of the soil, the elements of the environment, and the dynamics of the nutrients.

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